PORT ORANGE CITY COUNCIL

SPECIAL MEETING

Council Chambers

Tuesday, February 9, 2016 @ 6:00 PM

SPECIAL MEETING AGENDA

Pursuant to Section 3.06 of the Charter of the City of Port Orange, the Mayor has called a **Special Meeting** of the City Council to be held for the following purposes:

OPENING

1. Pledge of Allegiance
2. Silent Invocation
3. Roll Call

DISCUSSION ITEMS

4. Direction on whether or not to build the berm based on the CDM Smith Report "Stormwater Modeling for the Nova/Halifax Canal"

ADJOURNMENT

ANY PERSON WHO DECIDES TO APPEAL ANY DECISION MADE BY THE CITY COUNCIL WILL NEED A RECORD OF THE PROCEEDINGS, AND FOR SUCH PURPOSE HE OR SHE MAY NEED TO ENSURE AT HIS OR HER OWN EXPENSE FOR THE TAKING AND PREPARATION OF A VERBATIM RECORD OF ALL TESTIMONY AND EVIDENCE OF THE PROCEEDINGS UPON WHICH THE APPEAL IS TO BE BASED.

NOTE: IF YOU ARE A PERSON WITH A DISABILITY WHO NEEDS ANY ACCOMMODATION IN ORDER TO PARTICIPATE IN THIS PROCEEDING, YOU ARE ENTITLED, AT NO COST TO YOU, TO THE PROVISION OF CERTAIN ASSISTANCE. PLEASE CONTACT THE CITY CLERK FOR THE CITY OF PORT ORANGE, 1000 CITY CENTER CIRCLE, PORT ORANGE, FLORIDA 32129, TELEPHONE NUMBER 386-506-5563, WITHIN 2 WORKING DAYS OF YOUR RECEIPT OF THIS NOTICE OR 5 DAYS PRIOR TO THE MEETING DATE; IF YOU ARE HEARING OR VOICE IMPAIRED, CONTACT THE RELAY OPERATOR AT 1-800-955-8771.

CITY COUNCIL AGENDA ITEM

REQUESTED COUNCIL MEETING DATE **02/09/2016**

Consent item: No

SUBJECT: Direction on whether or not to build the berm based on the CDM Smith Report "Stormwater Modeling for the Nova/Halifax Canal"

DEPARTMENT: Public Utilities

GOAL: 1 - Infrastructure Preservation

OBJECTIVE: 2 - Develop infrastructure master plans including drainage, transportation and utilities to provide clear infrastructure needs

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RECOMMENDED MOTION: Move to accept CDM Smith, Inc. “Stormwater Modeling for the Nova/Halifax Canal” Task Authorization No. 1 final report finding and provide City staff direction on how to proceed on the berm construction.

SUMMARY: During the 2/2/2016 City Council meeting CDM Smith, Inc. presented their completed “Stormwater Modeling for the Nova/Halifax Canal” study per Task Authorization No. 1. The purpose of Task Authorization No. 1 is to analyze the benefits and risk factors associated with constructing the berm (or not) at the vicinity of Spruce Creek Road and Powers Avenue, and to provide alternative options to mitigate and/or to reduce the flooding stage at the drainage basin of Dunlawton Avenue and Ruth Street. City Council request one more week to review the information prior to providing direction at this meeting. At present time, there are two time sensitive items that are connected to the project.

First, The St. John’s River Water Management District permit is set to expire on March 23, 2016 which encumbered the entire Dunlawton Drainage project including the construction of the berm.

Second, FEMA Hazard Mitigation Grant is set to expire May 31, 2016. This grant provides partial funding for the Dunlawton Drainage project including the berm if approved by City Council.

A City Council decision will need to be made in order to start work or submit modification and project completion paperwork prior to the above permit and grant expiration dates.

CDM Smith will not be available in person for the Special Meeting however can be made available for phone briefings prior to the meeting by arranging through Cindy Rivera. The attached briefing is the same as was presented at the 2/2 Council meeting and the brief is available on the city website under the 2/2 council meeting. Cindy Rivera also has additional reports from all Engineer firms involved if required.

Project Funding Account

No.: No.:

ATTACHMENTS:

1.	CDM Report	Port Orange Task 4 TM To City.pdf
2.	CDM-Smith Presentation 2/2/2016	Port Orange City Council Presentation - CDM Smith Final-rev (02-02-2016).pptx

Fenwick, Robin	Created/Initiated - 02/03/2016
Neff, Andrew	Approved - 02/03/2016
Johansson, M. Jake	Final Approval - 02/03/2016

Memorandum

To: *City of Port Orange*

From: *CDM Smith*

Date: *January 14, 2016*

Subject: City of Port Orange Stormwater Modeling for the Nova/Halifax Canal – Technical Memorandum (Task 4)

CDM Smith was contracted by the City of Port Orange to apply an updated model of the Nova/Halifax Canal system, originally developed as part of previous work for the East Volusia Regional Water Authority (EVRWA), to evaluate the Dunlawton Avenue/Spruce Creek Road area that experienced significant flooding in September 2014. Tasks in the scope of services include:

- Task 1 – Review Models, Design Plans, and Permit
- Task 2 – Berm Alternatives Evaluation
- Task 3 – Additional Alternative and Recommendation
- Task 4 – Technical Memorandum and Quality Management

This technical memorandum (TM), the deliverable for Task 4, documents the work done under Tasks 1 through 3.

In Task 1, CDM Smith worked with the City to assemble and review relevant data and information necessary to conduct the analyses performed under Tasks 2 and 3. CDM Smith and the City also met with City residents at a public meeting held on November 10, 2015, to solicit feedback from the local community regarding the frequency and severity of flooding.

In Task 2, CDM Smith refined the base US EPA Storm Water Management Model (SWMM) used by Quentin L. Hampton Associates (QLH) to better represent conditions in the Dunlawton Avenue/Spruce Creek Road area following implementation of the Dunlawton Avenue Drainage Improvements, which included stormwater conveyance improvements along Ruth Street, enhancement of a pond system south of the Dunlawton Avenue/ Spruce Creek Road intersection (including expansion of two existing ponds plus an additional new pond), a stormwater pumping station, and an operable tide gate in the Halifax Canal. A low level berm (ranging from 6 to 24 inches high) was also originally proposed to control surface water stages. This berm was deleted from the constructed project. The potential implementation of the berm is a key question for this study.

The updated (City project) and refined (increased resolution and corrections) model was applied with and without the proposed berm to evaluate the potential impacts of the berm with respect to reducing flooding in the Dunlawton Avenue/ Spruce Creek Road area and potentially increasing water elevations and flooding outside the bermed area.

In Task 3, CDM Smith used the updated and refined SWMM developed in Task 2 to evaluate an alternative that the City may consider to further reduce or manage flooding in the Dunlawton Avenue/Spruce Creek Road area. This alternative considered additional conveyance capacity and storage to reduce or eliminate flooding and road overtopping for extreme storm events.

Task 1 Data Collection

Per the project scope, CDM Smith worked with stakeholders to obtain the following documents relevant to the ensuing Task 2 and Task 3 analyses:

- Rainfall data for the September 2014 flooding event from the City's nearby reclaimed water facility (9.0 inches from September 23-24).
- Photos and videos of street and property flooding taken by City personnel and emailed to the City by local residents in the project area associated with the September 2014 flooding event.
- City storm damage assessment databases from the May 2009 and September 2014 flooding events, and the 2012 FEMA Repetitive Loss Property Database.
- Survey and topographic CAD files prepared by QLH.
- Phase I (October 2010) and Phase II (May 2011) design plans for the *Dunlawton Avenue Drainage Improvements Project* prepared by QLH.
- As-built plans for the completed *Dunlawton Avenue Drainage Improvements Project* (June 2014) prepared by QLH.
- Applications, drainage reports, and supporting documentation for SJRWMD Environmental Resource Permits No. 40-129-29869-4 (Phase I, October 2010), and 40-129-29869-5 (Phase II, May 2011)
- Letter report entitled "*Review of Halifax Canal and proposed Canal Bank Berm along Spruce Creek Road north of Dunlawton Avenue*" prepared by Pegasus Engineering (March 2015).
- SWMM5 project model for *Dunlawton Avenue Drainage Improvements Project* prepared by QLH and based on the SWMM5 regional model developed by CDM Smith for the *Nova Canal Flood Control and Integrated Water Resources Program* (August 2010)

- Relevant portions of the City of Port Orange Land Development Code (Chapter 5, Section 4, and Chapter 10, Article II)

CDM Smith reviewed these data and used them as appropriate for the subsequent tasks.

Public Meeting

In order to gain feedback from the local community regarding the frequency and severity of flooding, CDM Smith attending a public meeting with residents and elected officials on November 10, 2015. CDM Smith presented an overview of the historical flooding issues in the project area and discussed the storage and flood control pumps recommended in the 2010 *Nova Canal Flood Control and Integrated Water Resources Program* report. The residents provided feedback on their experiences in the May 2009 and September 2014 storms, and provided CDM Smith with photographs, videos, and locations of specific flooding issues. CDM Smith used this local information to validate model results in Task 2.

The local news channel (WOFL – Fox 35) and newspaper (Daytona Beach News-Journal) video-taped this meeting and CDM Smith has requested this from the station (but has not received the videotape as of the date of this memorandum).

Task 2 Model Refinement

In the original EVRWA model that was modified by QLH to represent the drainage improvement project, the Halifax Canal is represented as a series of trapezoidal channels and culverts conveying flow, and surface water storage/flooding is represented by storage nodes along the canal. Within the area of most concern in this study (bounded by Herbert Street to the north, Lemon Street to the east and Oak Street to the south), the base model has two assigned storage nodes. The first storage node is located at the downstream side of Powers Avenue, receiving runoff inflow from one catchment east of the canal and another west of the canal. The second storage node is located upstream of the Oak Street crossing, and receives surface runoff inflow from a single catchment with area both east and west of the canal.

QLH Model Modifications for Project Conditions

The QLH model included the following modifications to the base EVRWA model developed by CDM Smith:

1. The hydrologic unit that contributes runoff to the storage node at Oak Street was split into two: one east of the canal (which discharges runoff flow to the enhanced pond system) and one west of the canal, still contributing runoff flow to the canal.

2. The enhanced pond system at the Dwayne Huffman Reclaimed Water Plant was modeled as a single storage node, accounting for the storage volume of all ponds in the system.

3. A weir representing the tide gate was added to the model, connecting the original storage node upstream of Oak Street with a new model node which becomes the new upstream end of the Oak Street culvert.

4. A pump was added, discharging flow from the enhanced pond system to the canal, at the new node upstream of Oak Street but downstream of the new tide gate. The pump discharge rate is 31 cfs, and is scheduled to turn on at a water elevation of 3.0 feet NGVD (1.8 feet NAVD) and turn off at a water elevation of 2.5 feet NGVD (1.3 feet NAVD).

5. An outlet structure from the enhanced pond system to the canal was added. This includes the outlet structure weir and orifice connected to an outfall pipe, which has a flap gate at the downstream end.

When the QLH model was run for the 25-year, 24-hour and 100-year, 24-hour design storms (rainfall depths of 9.5 and 13.0 inches, respectively), the model predicted reclaimed water plant pond system peak water elevations of 4.1 feet NGVD (2.9 feet NAVD) and 5.7 feet NGVD (4.5 feet NAVD), respectively.

CDM Model Refinements for Project Conditions

The QLH model was further refined to further represent project conditions and evaluate the potential impacts of the proposed berm. The refinements included the following:

1. Hydrologic units in the area of interest are modified, splitting two QLH hydrologic units east of the canal into a total of four:

   i. North of Dunlawton Avenue, including tributary area to the Sugar Mill Apartments pond and potential canal bank overflow north of Powers Avenue.

   ii. North of Dunlawton Avenue, including the triangular tributary area between Powers Avenue, Dunlawton Avenue, and the canal, and potential canal bank overflow between Powers Avenue and Dunlawton Avenue.

   iii. South of Dunlawton Avenue, tributary to the new pond and existing pond which are connected by a large box culvert (hereafter referred to as "eastern pond").

   iv. South of Dunlawton Avenue, tributary to the two existing ponds which were connected as part of the pond enhancements (hereafter referred to as "western pond").

2. Storage nodes are defined in each hydrologic unit to reflect natural surface storage plus new pond storage.

3. The Sugar Mill Apartments pond outfall structure (connected to canal with no flap gate) was added.

4. The pipe connection between the eastern and western ponds was added.

5. Overflow conduits were added to consider overland flow of Dunlawton Avenue (expected to flow from north to south), overflow of canal north of Dunlawton Avenue, and overflow at Oak Street (which may flow from south to north if downstream water elevation is higher than water elevation in the area of interest due to the pumping).

6. Inlets and associated pipes conveying flow from north to south side of Dunlawton Avenue were added.

7. The pipe under Oak Street at the existing ditch was added.

When the updated and refined project model was run for the 25-year, 24-hour and 100-year, 24-hour design storms (rainfall depths of 9.5 and 13.0 inches, respectively), the model predicted pond system peak water elevations of 6.5 feet NGVD (5.3 feet NAVD) and 6.9 feet NGVD (5.7 feet NAVD), respectively. These results are consistent with the water elevations observed in the September 2014 storm event (rainfall of 8.6 inches), which appeared to be in the range of 6.1 to 6.6 feet NGVD (4.9 to 5.4 feet NAVD) along Ruth Street.

Berm Evaluation with Refined Project Model

The refined model was run for the 10-year, 24-hour design storm (8.0 inches) as well as the 25-year and 100-year design storms. The “no-berm” scenario was represented by the base refined model, which included bank overflow conduits with elevations taken from the record drawings. The “with berm” scenario was evaluated by modifying the bank overflow conduits to reflect the proposed berm top elevation of 7.2 feet NGVD (6.0 feet NAVD).

Results of the analysis are summarized in **Table 1**. For each design storm, the table lists the peak water elevation in feet NGVD at locations in the area of concern as well as upstream and downstream. **Figure 1** shows the location of the SWMM nodes in the area of interest, and also shows the approximate location of low-lying areas, which are discussed later in this memorandum.

In general, the results indicate that the initially proposed berm would have minimal benefit in the area of interest. In all cases, the maximum benefit (peak water elevation reduction) resulting from berm implementation is 0.1 foot. ***The results also indicate the berm results in peak water elevation increases upstream of the berm, ranging from 0.1 foot increase for the 10-year and 25-year events, to 0.3 foot for the 100-year event***.

Because of the minimal peak water elevation reduction in the project area and increase in upstream peak water elevation caused by the berm, ***CDM Smith concludes that the berm itself does not provide sufficient benefit to justify implementation as configured***. It is conceivable that berm implementation in conjunction with other improvements may provide some benefit without adversely affecting peak water elevations outside the protected area.

Table 1. Peak Water Elevations (feet NGVD) with and without Proposed Berm

SWMM Node	Location	Peak Water Elevation (feet NGVD)		
		10-Year Design Storm		
		No Berm	With Berm	Difference
	Halifax Canal			
138	Downstream side of Ryanwood Road	6.8	6.8	0.0
2301HAL	Upstream side of Powers Avenue	6.5	6.6	0.1
134	Downstream side of Powers Avenue	6.1	6.2	0.0
3000	Upstream side of Dunlawton Avenue	6.1	6.1	0.0
3001	Downstream side of Dunlawton Avenue	6.1	6.1	0.0
141	Upstream side of new inline weir structure	6.0	6.1	0.0
QLH-141	Downstream side of new inline weir /upstream side of Oak Street	6.0	6.0	0.0
2901HAL	Downstream side of Oak Street	6.0	6.0	0.0
BUSCHIN	At inlet channel to Buschman Pond	4.9	4.9	0.0
	Area of Improvements			
20134E	Sugar Mill Apartments pond and surrounding area	6.5	6.4	-0.1
20134S	Triangular area between canal, Powers Avenue, and Dunlawton Avenue	6.1	6.1	0.0
20142E	Eastern pond (pond SW1 plus new pond)	5.9	5.9	0.0
20142W	Western pond (pond SW2 + SW3)	6.1	6.1	0.0

SWMM Node	Location	Peak Water Elevation (feet NGVD)		
		25-Year Design Storm		
		No Berm	With Berm	Difference
	Halifax Canal			
138	Downstream side of Ryanwood Road	6.9	7.0	0.1
2301HAL	Upstream side of Powers Avenue	6.7	6.8	0.1
134	Downstream side of Powers Avenue	6.4	6.4	-0.1
3000	Upstream side of Dunlawton Avenue	6.4	6.4	0.0
3001	Downstream side of Dunlawton Avenue	6.4	6.4	0.0
141	Upstream side of new inline weir structure	6.3	6.3	0.0
QLH-141	Downstream side of new inline weir /upstream side of Oak Street	6.3	6.2	0.0
2901HAL	Downstream side of Oak Street	6.0	6.0	0.0
BUSCHIN	At inlet channel to Buschman Pond	5.2	5.2	0.0
	Area of Improvements			
20134E	Sugar Mill Apartments pond and surrounding area	6.6	6.5	-0.1
20134S	Triangular area between canal, Powers Avenue, and Dunlawton Avenue	6.5	6.5	0.0
20142E	Eastern pond (pond SW1 plus new pond)	6.3	6.2	0.0
20142W	Western pond (pond SW2 + SW3)	6.5	6.5	0.0

		Peak Water Elevation (feet NGVD)		
		100-Year Design Storm		
		No Berm	With Berm	Difference
	Halifax Canal			
138	Downstream side of Ryanwood Road	7.3	7.5	0.2
2301HAL	Upstream side of Powers Avenue	7.0	7.3	0.3
134	Downstream side of Powers Avenue	6.9	6.8	-0.1
3000	Upstream side of Dunlawton Avenue	6.9	6.8	-0.1
3001	Downstream side of Dunlawton Avenue	6.9	6.8	-0.1
141	Upstream side of new inline weir structure	6.8	6.7	-0.1
QLH-141	Downstream side of new inline weir /upstream side of Oak Street	6.8	6.7	-0.1
2901HAL	Downstream side of Oak Street	6.7	6.7	-0.1
BUSCHIN	At inlet channel to Buschman Pond	5.7	5.7	0.0
	Area of Improvements			
20134E	Sugar Mill Apartments pond and surrounding area	7.0	6.9	-0.1
20134S	Triangular area between canal, Powers Avenue, and Dunlawton Avenue	6.9	6.9	0.0
20142E	Eastern pond (pond SW1 plus new pond)	6.7	6.7	-0.1
20142W	Western pond (pond SW2 + SW3)	6.9	6.9	0.0

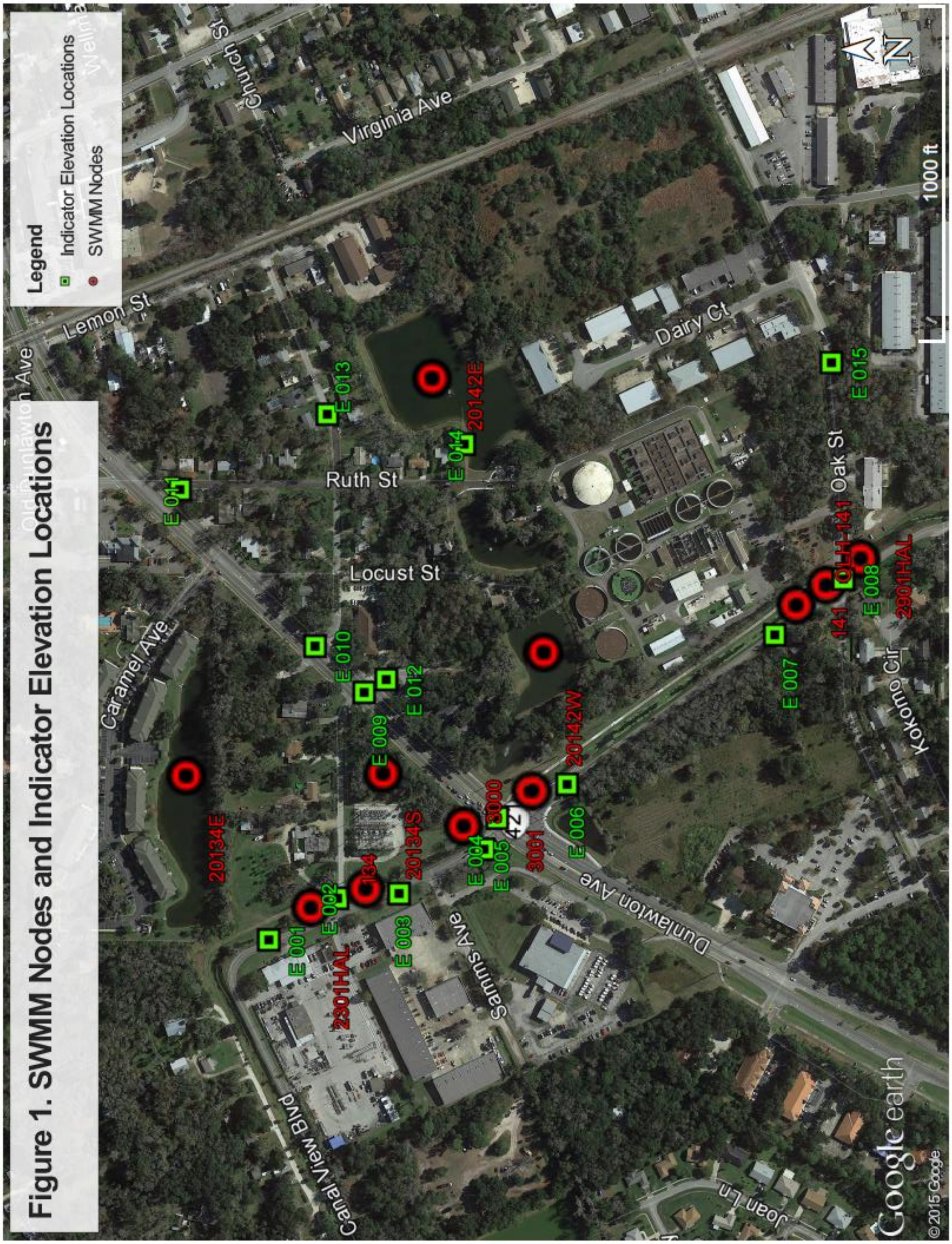


Figure 1. SWMM Nodes and Indicator Elevation Locations

Characterization of Flooding under Current Conditions

The Dunlawton Avenue/Spruce Creek Road area has historically flooded. Previous studies (e.g., EVRWA, 2010) identified the potential for almost 800 acre-feet of surface water volume in the City for the 100-year storm event, including over 100 acre-feet of volume in the Dunlawton Avenue/Spruce Creek Road area. The EVRWA study also recommended a 300 cfs (200 MGD) flood control pump station from Buschman Park to the Halifax River, which provided substantial reduction in peak water elevation near Buschman Park and some benefit (0.1 – 0.2 foot peak water elevation reduction) in the Dunlawton Avenue/Spruce Creek Road area.

In contrast, the constructed project added approximately 3 acres of expanded and new storage lake surface (approximately 10 acre-feet of live storage between the normal water level and the top of bank elevation) and a smaller 31 cfs pump station to the Halifax Canal downstream of a tide gate rather than directly to the Halifax River.

Therefore, it is expected that additional storage and/or conveyance is needed to reduce or eliminate flooding and road overtopping in this area for extreme storm events. For the analysis of a flood control alternative, the goal was to keep the peak water elevation below the minimum roadway crown elevation for Dunlawton Avenue (5.8 feet NGVD/4.6 feet NAVD) and Ruth Street (5.5 feet NGVD/4.3 feet NAVD), considering that Dunlawton Avenue represents a flood evacuation route and Ruth Street is primary ingress and egress for residents.

In the formulation of this alternative, flood photographs from citizens from the November 10, 2015 public meeting coupled with modeling results from Task 2 were analyzed to characterize the degree of flooding and sources of flooding in the Dunlawton Avenue/Spruce Creek Road Area. Results for the 10-year, 25-year and 100-year, 24-hour design storm events are presented in **Table 2**. This table summarizes volumes of stormwater entering the study area from various sources, including:

- direct tributary area rainfall and runoff,
- backflow through the Sugar Mill Apartments pond outlet structure,
- canal bank overflow, and
- backflow across Oak Street from high downstream water levels.

All results are based on a 5 day (120 hour) simulation period, with the design storm rainfall on the first day and no rainfall on the following four days.

In the area north of Dunlawton Avenue, the major flow contributor depends upon the return period of the design storm. For the 10-year event, backflow through the Sugar Mill Apartments pond accounts for the majority of inflow, whereas canal bank overflow is the primary contributor for larger events, particularly for the 100-year event.

In the area south of Dunlawton Avenue, the major flow contributor also depends upon the return period of the design storm. For the 10-year and 25-year events, backflow across Oak Street is the primary source of inflow, whereas Dunlawton Avenue overflow is the primary contributor for larger events, particularly for the 100-year event.

As an indicator of flooding and flood reduction, the road crowns for known problem areas (e.g., Dunlawton Avenue, Ruth Street, Spruce Creek Road, Powers Avenue, et al) were evaluated versus peak flood stages to determine flood depth and reduction for additional alternative facilities to augment the existing project.

Table 2. Runoff/Flow Sources in the Study Area for Current Base Project Conditions

Runoff/Flow Source	Inflow (Million Gallons/Acre-Feet)		
	10-Year	25-Year	100-Year
North of Dunlawton Avenue			
Backflow through Sugar Mill Apartments pond outfall structure	10.8/33.1	16.1/49.4	19.7/60.5
Bank overflow north of Powers Avenue	4.8/14.7	17.0/52.2	74.0/227.1
Bank overflow between Powers and Dunlawton Avenue	-0.7/-2.1	-12.3/-37.7	-50.0/-153.4
Surface runoff	5.0/15.3	6.2/19.0	9.1/27.9
TOTAL (North of Dunlawton)	19.9/61.3	27.0/82.9	52.8/162.0
South of Dunlawton Avenue			
Dunlawton Avenue overflow (from north to south)	3.1/9.5	11.9/36.5	39.6/121.5
Oak Street backflow	29.6/90.8	33.9/104.0	23.7/72.7
Surface runoff	12.7/39.0	15.6/47.9	22.4/68.7
TOTAL (South of Dunlawton)	45.4/139.3	61.4/188.4	85.7/263.0
TOTAL (excludes flow transfer across Dunlawton)	62.2/190.9	76.5/234.8	98.9/303.5

Note: 1 MG = 3.07 acre-feet

In order to avoid Dunlawton Road overtopping, an alternative would have to effectively store or convey elsewhere (to storage and/or pumping) the cumulative volume of flow coming in from the various sources (Sugar Mill Apartment pond outfall structure backflow, surface runoff, and canal bank overflow north of Powers Avenue). For the various design events, this would amount to 63 acre-feet for the 10-year event to 314 acre-feet for the 100-year event, which would have to be stored at an elevation below the crown of the Dunlawton Avenue roadway, which has a minimum elevation of 5.8 feet NGVD (4.6 feet NAVD) in the project area. Considering that the area north of Dunlawton Avenue is approximately 30 acres, the maximum storage that could be provided between the tailwater elevation of 3.0 feet NGVD (1.8 feet NAVD) and the minimum crown elevation of 5.8 feet NGVD (4.6 feet NAVD) is 84 ac-ft, and storage over this entire area would not be feasible.

Consequently, the alternative project will consider conveyance (e.g., pumping) out of the project area, and to the Halifax River (similar to the Buschman Pond pumping alternative considered in the EVRWA study by CDM Smith).

If the Dunlawton Avenue overtopping is eliminated, the sources of flow to the ponds in the vicinity of the Dwayne Huffman Reclaimed Water Plant would include backflow across Oak Street and surface runoff. The alternative project will consider modification of Oak Street (e.g., raising the roadway) to reduce the larger storm event backflow volume across Oak Street.

Characterization of Alternative Project

The alternative project model includes the following modifications to the refined model described earlier:

- A pump was added to convey flow from the Sugar Mill Apartments pond (storage node in catchment 20134E which accounts for storage in the Sugar Mill Apartments pond plus surrounding low-lying areas) to the Halifax River. The pump capacity was determined to be 125 cubic feet per second (cfs), which is equivalent to 80.8 million gallons per day (MGD). This pumping rate was required to maintain peak water elevation below the minimum crown elevation of Dunlawton Avenue during the 100-year design storm event. Flow rates from 50 to 125 cfs were tested. The water would be pumped via force main to the Halifax River. The pump would turn on when the water level reaches 4.9 feet NGVD (3.7 feet NAVD), which is equivalent to a low spot near the intersection of Powers Avenue and Dunlawton Avenue. The pump would turn off when the water level reaches 2.7 feet NGVD (1.5 feet NAVD) which is 1 foot below the normal pool orifice elevation for the Sugar Mill Apartments pond outlet structure.

- An inlet with associated 36-inch pipe (which was modeled) or equivalent open channel (route to be determined) would be added to convey water from the low spot near the intersection of Powers Avenue and Dunlawton Avenue (near location E 009 on Figure 1) to the pump station at the Sugar Mill pond.

- The Oak Street roadway would be raised up to 1 foot at its existing low point, resulting in a modified minimum roadway crown elevation of 6.5 feet NGVD (5.3 feet NAVD). The existing horizontal elliptical pipe at that location would be supplemented by a second parallel pipe of the same size, so that normal gravity flow from the site during lower tailwater conditions would still occur. Some limited backflow will still occur for larger events but it does not cause any adverse impacts for the evaluated storms (5, 10, 25, 100 yr 24 hour or the May 2009 event). The second pipe was added to avoid potential stage increases in the canal at Oak Street and at upstream canal nodes for the 10-year design storm.

Model Results with Alternative Project Components

The model with the alternative project was run for the 10-year, 25-year and 100-year 24 hour design storms. Key considerations in the analysis included the reduction of road overtopping at Dunlawton Avenue, reduction of flooding and road overtopping along Ruth Street, and no adverse impacts (e.g., peak water elevation increases) outside of City rights-of-way (ROWs).

Flooding sources with the alternative project are summarized in **Table 3**. Comparison with Table 2 indicates that lowering the peak water elevation in the area north of Dunlawton Avenue through pumping actually draws more water into the area through the Sugar Mill Apartments pond outfall structure backflow, and overtopping of the Halifax Canal bank. As shown in the table, the pumping schedule and pump capacity are able to prevent Dunlawton Avenue overflow to the area south of the road.

Backflow volume through the culverts under Oak Street is increased for all events with the alternative project, though the peak backflow rate (in cubic feet per second) is lower under the alternative project for the larger events because there is no roadway overtopping backflow in the alternative project. Again, the lower peak water elevations in the water plant ponds south of Dunlawton Avenue will draw more water to the site, but the backflow is limited by raising the road and allowing backflow only through the existing pipe and proposed parallel pipe under Oak Street.

Results for all of the evaluated storms were compared to elevations (e.g., roadway crown elevations) at locations throughout the area of interest. These locations are shown in **Table 4** and Figure 1. The table lists the selected locations, description of the feature (e.g., road crown), associated SWMM node, and the elevation in feet NAVD and NGVD. The figure illustrates the approximate location of the tabulated elevations and shows the location of the SWMM nodes in the area of interest. It should be noted that all elevations are rounded to the nearest 0.1 feet; therefore, some Differences may not appear to be equal to the Alternative minus the Base Project.

Peak water elevation results for the alternative project are summarized in **Table 5**. For each design storm, the table lists the peak water elevation in feet NGVD at locations in the area of concern as well as upstream and downstream. In almost all cases, the results indicate that the alternative project will result in peak water elevations equal to or lower than current conditions, particularly in the project area. For all of these design storm events, the peak water elevation is generally kept at or below the minimum roadway crown elevation for Dunlawton Avenue (5.8 feet NGVD/4.6 feet NAVD) and Ruth Street (5.5 feet NGVD/4.3 feet NAVD).

The only observed increase in peak water elevation was at node 141 for the 10-year design storm. It should be noted that the 0.1 foot increase is based on rounding the model peak water elevation results to the nearest 0.1 foot. Comparing model results for the two scenarios (which are calculated to two decimal places in SWMM), the difference is 0.02 feet. It should also be noted that the 10-year design storm peak water elevation is less than the roadway crown elevation on Spruce Creek Road at that location (in other words, an increase in peak water elevation will not result in increased road overtopping).

Table 3. Runoff/Flow Sources in the Study Area with Base Project plus Alternative Components

Flooding Source	Inflow (Million Gallons/Acre-Feet)		
	10-Year	25-Year	100-Year
North of Dunlawton Avenue			
Backflow through Sugar Mill Apartments pond outfall structure	18.7/57.4	26.6/81.6	44.4/136.2
Bank overflow north of Powers Avenue	2.5/7.7	7.1/21.8	25.1/77.0
Bank overflow between Powers and Dunlawton Avenue	3.6/11.0	8.1/24.9	22.7/69.7
Surface runoff	5.0/15.3	6.2/19.0	9.1/27.9
TOTAL (North of Dunlawton)	29.8/91.4	48.0/147.3	101.3/310.9
South of Dunlawton Avenue			
Dunlawton Avenue overflow (from north to south)	0.0/0.0	0.0/0.0	0.0/0.0
Oak Street backflow	38.0/116.6	41.8/128.3	50.1/153.7
Surface runoff	12.7/39.0	15.6/47.9	22.4/68.7
TOTAL (South of Dunlawton)	50.7/155.6	57.4/176.1	72.5/222.5
TOTAL (excludes flow transfer across Dunlawton)	80.5/247.0	105.4/323.4	173.8/533.3

Note: 1 MG = 3.07 acre-feet

Table 4. Indicator Elevations in the Area of Interest

Location ID	Description	SWMM Node	Elevation (feet NGVD /NAVD)
E 001	Road crown elevation, Spruce Creek Road north of Powers Avenue crossing	2301HAL	7.2 / 6.0
E 002	Road crown elevation, Powers Avenue crossing of Halifax Canal	2301HAL	6.9 / 5.7
E 003	Road crown elevation, Spruce Creek Road between Powers Avenue and Samms Avenue	134	7.1 / 5.9
E 004	Road crown elevation, Spruce Creek Road north of Dunlawton Avenue crossing	3000	6.6 / 5.4
E 005	Road crown elevation, Dunlawton Avenue crossing of Canal	3000	7.5 / 6.3
E 006	Road crown elevation, Spruce Creek Road south of Dunlawton Avenue	3001	6.5 / 5.3
E 007	Upstream side of new inline weir structure	141	6.5 / 5.3
E 008	Road crown elevation, Oak Street crossing of Halifax Canal	QLH-141	6.3 / 5.1
E 009	Road crown elevation, Dunlawton Avenue at western branch of Powers Avenue	20134S	5.8 / 4.6
E 010	Road crown elevation, Dunlawton Avenue at eastern branch of Powers Avenue	20134E	6.1 / 4.9
E 011	Road crown elevation, Ruth Street near intersection with Dunlawton Avenue	20142E	5.5 / 4.3
E 012	Road crown elevation, Roselle Street near intersection with Dunlawton Avenue	20142W	5.8 / 4.6
E 013	Road crown elevation, Powers Avenue east of Ruth Street	20142E	6.1 / 4.9
E 014	Storm water inlet elevation east of 546 Ruth Street	20142E	5.5 / 4.3
E 015	Road crown elevation, Oak Street at culvert	2901HAL	5.5 / 4.3

Table 5. Peak Water Elevations (feet NGVD) with Base Project plus Alternative Components

SWMM Node	Location	Indicator Elevation (feet NGVD)	Peak Water Elevation (feet NGVD) 10-Year Design Storm		
			Base Project	Alternative	Difference
	Halifax Canal				
138	Downstream side of Ryanwood Road		6.8	6.7	-0.1
2301HAL	Upstream side of Powers Avenue	6.9	6.5	6.5	0.0
134	Downstream side of Powers Avenue	7.1	6.1	6.1	0.0
3000	Upstream side of Dunlawton Avenue	6.6	6.1	6.1	0.0
3001	Downstream side of Dunlawton Avenue	6.5	6.1	6.1	0.0
141	Upstream side of new inline weir structure	6.5	6.0	6.1	0.1
QLH-141	Downstream side of new inline weir /upstream side of Oak Street	6.3	6.0	6.0	0.0
2901HAL	Downstream side of Oak Street	5.5/6.5	6.0	6.0	0.0
BUSCHIN	At inlet channel to Buschman Pond		4.9	4.9	0.0
	Area of Improvements				
20134E	Sugar Mill Apartments pond and surrounding area	5.8	6.5	4.9	-1.6
20134S	Triangular area between canal, Powers Avenue, and Dunlawton Avenue	6.1	6.1	5.2	-0.9
20142E	Eastern pond (pond SW1 plus new pond)	5.5	5.9	4.8	-1.1
20142W	Western pond (pond SW2 + SW3)	5.8	6.1	4.8	-1.3

SWMM Node	Location	Indicator Elevation (feet NGVD)	Peak Water Elevation (feet NGVD)		
			25-Year Design Storm		
			Base Project	Alternative	Difference
	Halifax Canal				
138	Downstream side of Ryanwood Road		6.9	6.9	0.0
2301HAL	Upstream side of Powers Avenue	6.9	6.7	6.6	-0.1
134	Downstream side of Powers Avenue	7.1	6.4	6.2	-0.1
3000	Upstream side of Dunlawton Avenue	6.6	6.4	6.2	-0.2
3001	Downstream side of Dunlawton Avenue	6.5	6.4	6.2	-0.2
141	Upstream side of new inline weir structure	6.5	6.3	6.2	-0.1
QLH-141	Downstream side of new inline weir /upstream side of Oak Street	6.3	6.3	6.1	-0.2
2901HAL	Downstream side of Oak Street	5.5/6.5	6.3	6.1	-0.2
BUSCHIN	At inlet channel to Buschman Pond		5.2	5.2	0.0
	Area of Improvements				
20134E	Sugar Mill Apartments pond and surrounding area	5.8	6.6	4.9	-1.7
20134S	Triangular area between canal, Powers Avenue, and Dunlawton Avenue	6.1	6.5	5.3	-1.2
20142E	Eastern pond (pond SW1 plus new pond)	5.5	6.3	5.1	-1.2
20142W	Western pond (pond SW2 + SW3)	5.8	6.5	5.1	-1.4

SWMM Node	Location	Indicator Elevation (feet NGVD)	Peak Water Elevation (feet NGVD) 100-Year Design Storm		
			Base Project	Alternative	Difference
	Halifax Canal				
138	Downstream side of Ryanwood Road		7.3	7.2	-0.1
2301HAL	Upstream side of Powers Avenue	6.9	7.0	6.8	-0.2
134	Downstream side of Powers Avenue	7.1	6.9	6.4	-0.5
3000	Upstream side of Dunlawton Avenue	6.6	6.9	6.3	-0.6
3001	Downstream side of Dunlawton Avenue	6.5	6.9	6.3	-0.6
141	Upstream side of new inline weir structure	6.5	6.8	6.3	-0.5
QLH-141	Downstream side of new inline weir /upstream side of Oak Street	6.3	6.8	6.3	-0.5
2901HAL	Downstream side of Oak Street	5.5/6.5	6.8	6.3	-0.5
BUSCHIN	At inlet channel to Buschman Pond		5.7	5.7	0.0
	Area of Improvements				
20134E	Sugar Mill Apartments pond and surrounding area	5.8	7.0	4.9	-2.1
20134S	Triangular area between canal, Powers Avenue, and Dunlawton Avenue	6.1	6.9	5.5	-1.4
20142E	Eastern pond (pond SW1 plus new pond)	5.5	6.8	5.6	-1.2
20142W	Western pond (pond SW2 + SW3)	5.8	6.9	5.6	-1.3

Other potential measures that were considered as part of the alternative included the following:

- Storage along the Halifax Canal near the project area. There is a parcel of land west of the canal (approximately 8 acres) that could be used for additional storage.
- Re-routing the pumped discharge from the ponds south of Dunlawton Avenue to the Halifax River, rather than back to the canal.

Model results showed minimal benefit (0.1 foot or less peak water elevation reduction) as a result of implementing either of these measures, and therefore they were not included in the final alternative. However, it should be noted that addition of 10 acre-feet of storage at the parcel west of the canal would eliminate the calculated slight increase in peak water elevation at node 141 for the 10-year storm if necessary. It should also be noted that the EVRWA study had recommended a flow diversion and pumping project at a downstream location (Buschman pond). If implemented, that project would provide a slight decrease in peak water elevations within the study area.

Results for Other Storms

Based on the project scope, the refined model and alternative model were applied for the 5-year design storm and the May 2009 historical event. Simulation of the May 2009 event included historical rainfall and tidal boundary water elevations. In the Port Orange area, the May 2009 event included a total of 20.63 inches of rainfall over a seven-day period, with a maximum daily rainfall of 6.37 inches. The 5-year design storm has a rainfall of 6.5 inches over a 24-hour period. The results for these storms are presented in **Table 6**. Again, the results show peak water elevations less than or equal to current conditions, and significant reductions in the area of interest.

Summary for Flood Control Alternative

An alternative list of project components was evaluated to consider what measures would be required to reduce or manage flooding in the Dunlawton Avenue/Spruce Creek Road area. It appears impracticable to add the necessary storage (between 63 to 314 acre-feet) to reduce the flooding to below indicator road elevations for the 10 through 100 year storms due to the relatively built-out nature of the area, the large flood volume, and the limited vertical distance between the design tailwater elevation and the low roadway crown elevation on Dunlawton Avenue.

It appears that an effective alternative to reduce flooding is pumping excess stormwater to the Halifax River; thereby, reducing flooding of the roadway and flow over the roadway into the area south of Dunlawton Avenue. The other key components are a pipe or channel from the low spot at Dunlawton Avenue to the proposed pump station at the Sugar Mill Apartments and raising Oak Street to reduce potential backflow into the area between Dunlawton Avenue and Oak Street. With these measures, peak water elevations during extreme design storm events are reduced by 1 to 2 feet in the area that was inundated by the 10-year, 25-year, and 100-year design storms as well as the May 2009 and September 2014 storms.

cc: File

Table 6. Peak Water Elevations (feet NGVD) with Base Project plus Alternative Components

SWMM Node	Location	Indicator Elevation (feet NGVD)	Peak Water Elevation (feet NGVD) 5-Year Design Storm		
			Base Project	Alternative	Difference
	Halifax Canal				
138	Downstream side of Ryanwood Road		6.5	6.5	0.0
2301HAL	Upstream side of Powers Avenue	6.9	6.3	6.3	0.0
134	Downstream side of Powers Avenue	7.1	6.0	5.9	-0.1
3000	Upstream side of Dunlawton Avenue	6.6	6.0	5.9	-0.1
3001	Downstream side of Dunlawton Avenue	6.5	6.0	5.9	-0.1
141	Upstream side of new inline weir structure	6.5	5.9	5.9	0.0
QLH-141	Downstream side of new inline weir /upstream side of Oak Street	6.3	5.9	5.8	-0.1
2901HAL	Downstream side of Oak Street	5.5/6.5	5.9	5.8	-0.1
BUSCHIN	At inlet channel to Buschman Pond		4.6	4.6	0.0
	Area of Improvements				
20134E	Sugar Mill Apartments pond and surrounding area	5.8	6.1	4.9	-1.2
20134S	Triangular area between canal, Powers Avenue, and Dunlawton Avenue	6.1	5.3	5.1	-0.2
20142E	Eastern pond (pond SW1 plus new pond)	5.5	4.5	4.5	0.0
20142W	Western pond (pond SW2 + SW3)	5.8	4.9	4.5	-0.4

SWMM Node	Location	Indicator Elevation (feet NGVD)	Peak Water Elevation (feet NGVD) May 2009 Historical Event		
			Base Project	Alternative	Difference
	Halifax Canal				
138	Downstream side of Ryanwood Road		7.2	7.1	-0.1
2301HAL	Upstream side of Powers Avenue	6.9	7.0	6.7	-0.3
134	Downstream side of Powers Avenue	7.1	7.0	6.3	-0.7
3000	Upstream side of Dunlawton Avenue	6.6	6.9	6.3	-0.6
3001	Downstream side of Dunlawton Avenue	6.5	6.9	6.3	-0.6
141	Upstream side of new inline weir structure	6.5	6.9	6.3	-0.6
QLH-141	Downstream side of new inline weir /upstream side of Oak Street	6.3	6.8	6.3	-0.5
2901HAL	Downstream side of Oak Street	5.5/6.5	6.8	6.3	-0.5
BUSCHIN	At inlet channel to Buschman Pond		5.6	5.4	-0.2
	Area of Improvements				
20134E	Sugar Mill Apartments pond and surrounding area	5.8	7.0	4.9	-1.7
20134S	Triangular area between canal, Powers Avenue, and Dunlawton Avenue	6.1	7.0	5.5	-1.5
20142E	Eastern pond (pond SW1 plus new pond)	5.5	6.8	5.6	-1.2
20142W	Western pond (pond SW2 + SW3)	5.8	7.0	5.6	-1.4

City of Port Orange
Stormwater Modeling for the Nova/Halifax Canal

CDM Smith





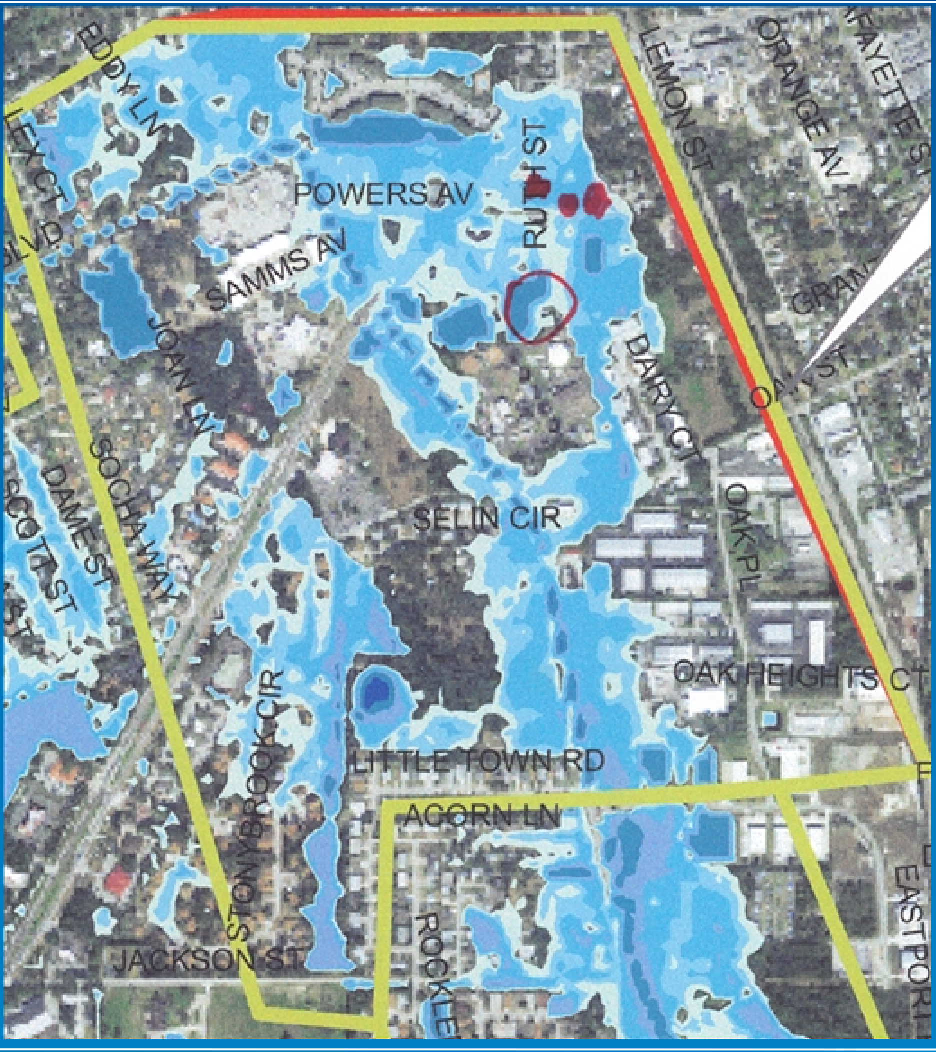

City Council Presentation

February 2, 2016

Background and Overview of Assignment

- Review stormwater model, design plans, permit
- Berm alternative evaluation
- Additional alternative and recommendation
- Technical memorandum
- Meetings and presentation

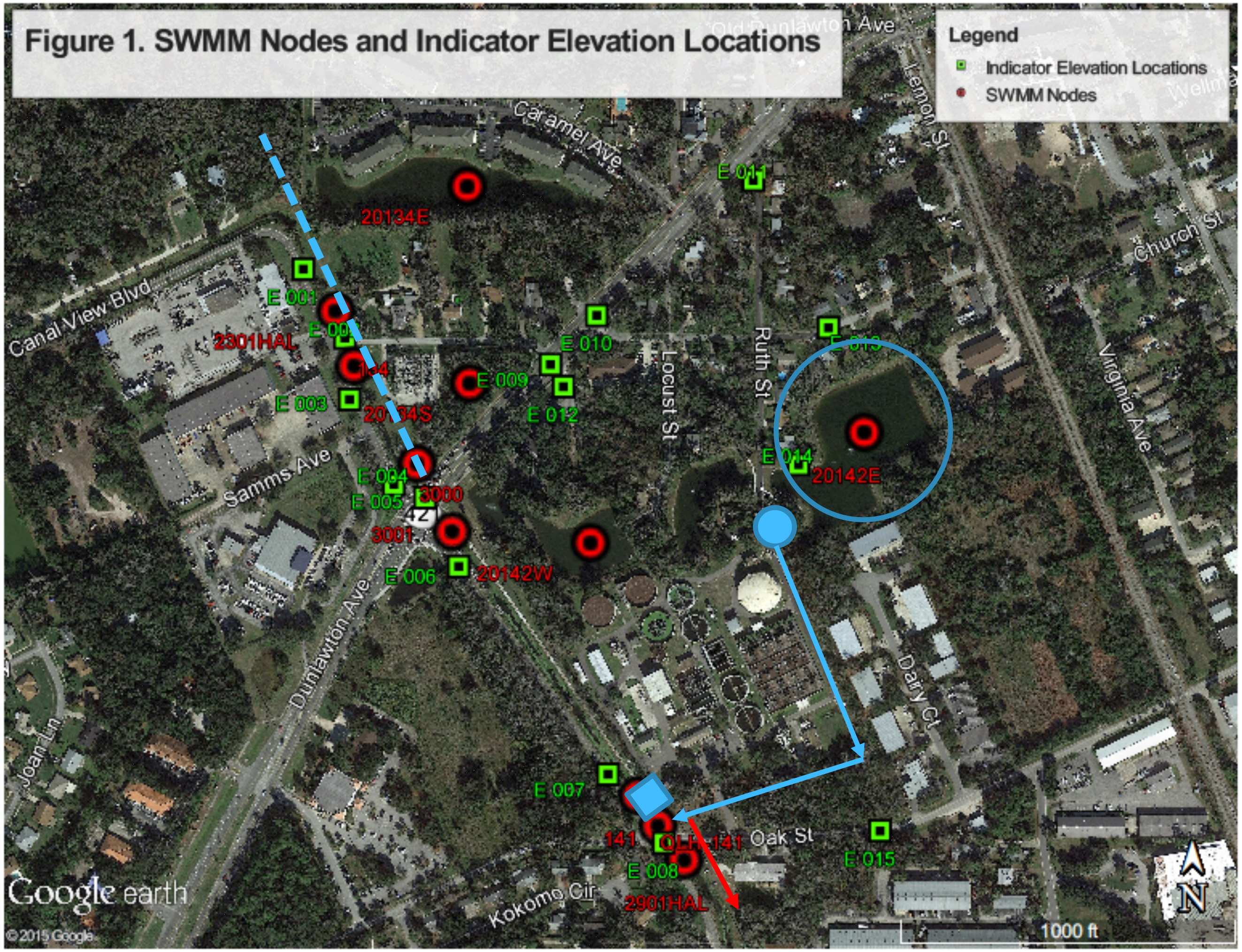
Historic Flood Areas from EVRWA Nova Road Canal Project



- Modeled 100-year storm flooding conditions between Ryanwood Road and Eastport Park Way

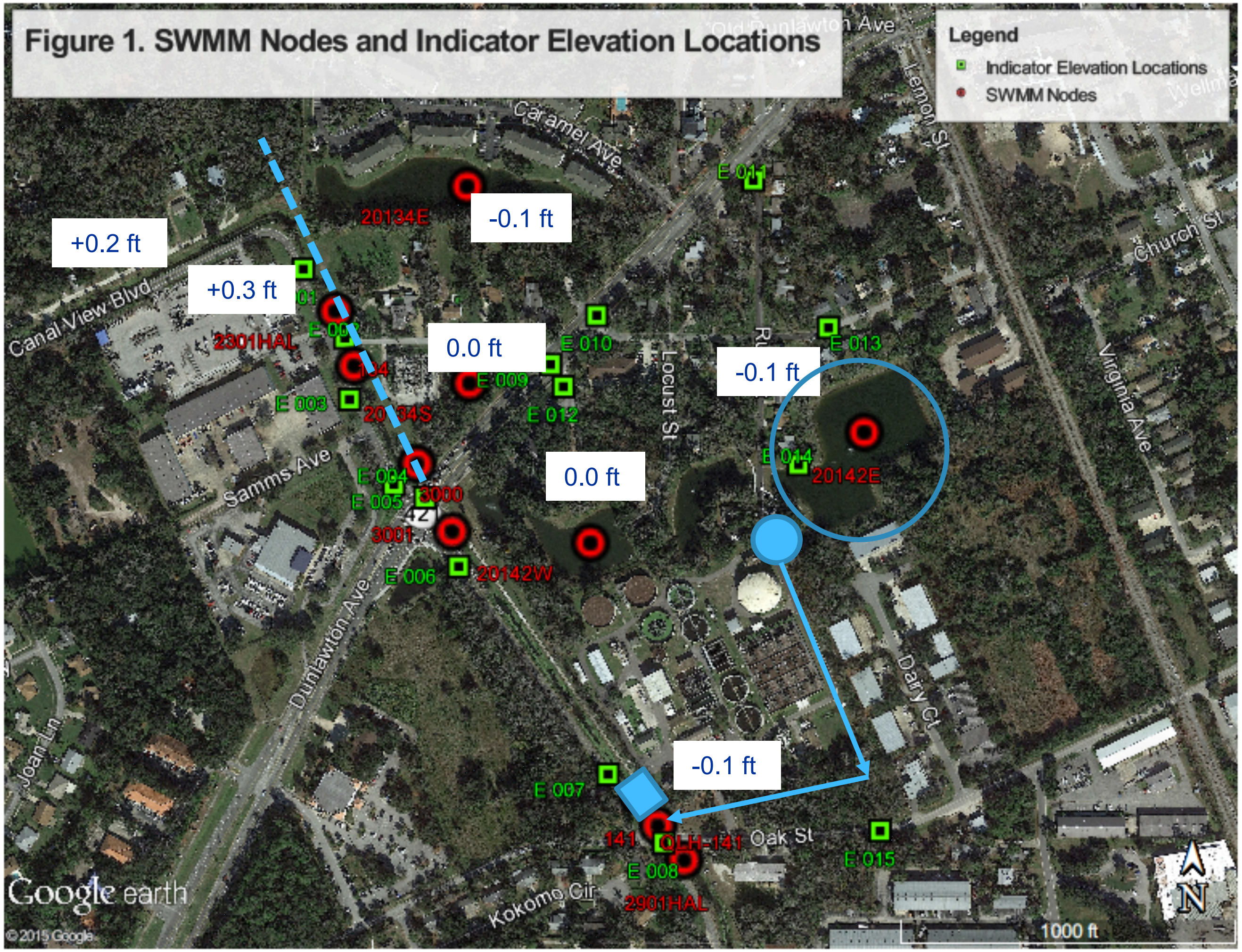
Stormwater Model and Implemented Project

- Detention lake of 2.8 acres
- Tide gate
- Pump station to canal (downstream of tide gate)
- Berm (permitted but not constructed)



Berm Evaluation

- Modeled without and with berm
- Flood stage increases west of berm
- Limited peak stage reduction east and downstream
- Berm <u>not</u> recommended since it will increase flooding



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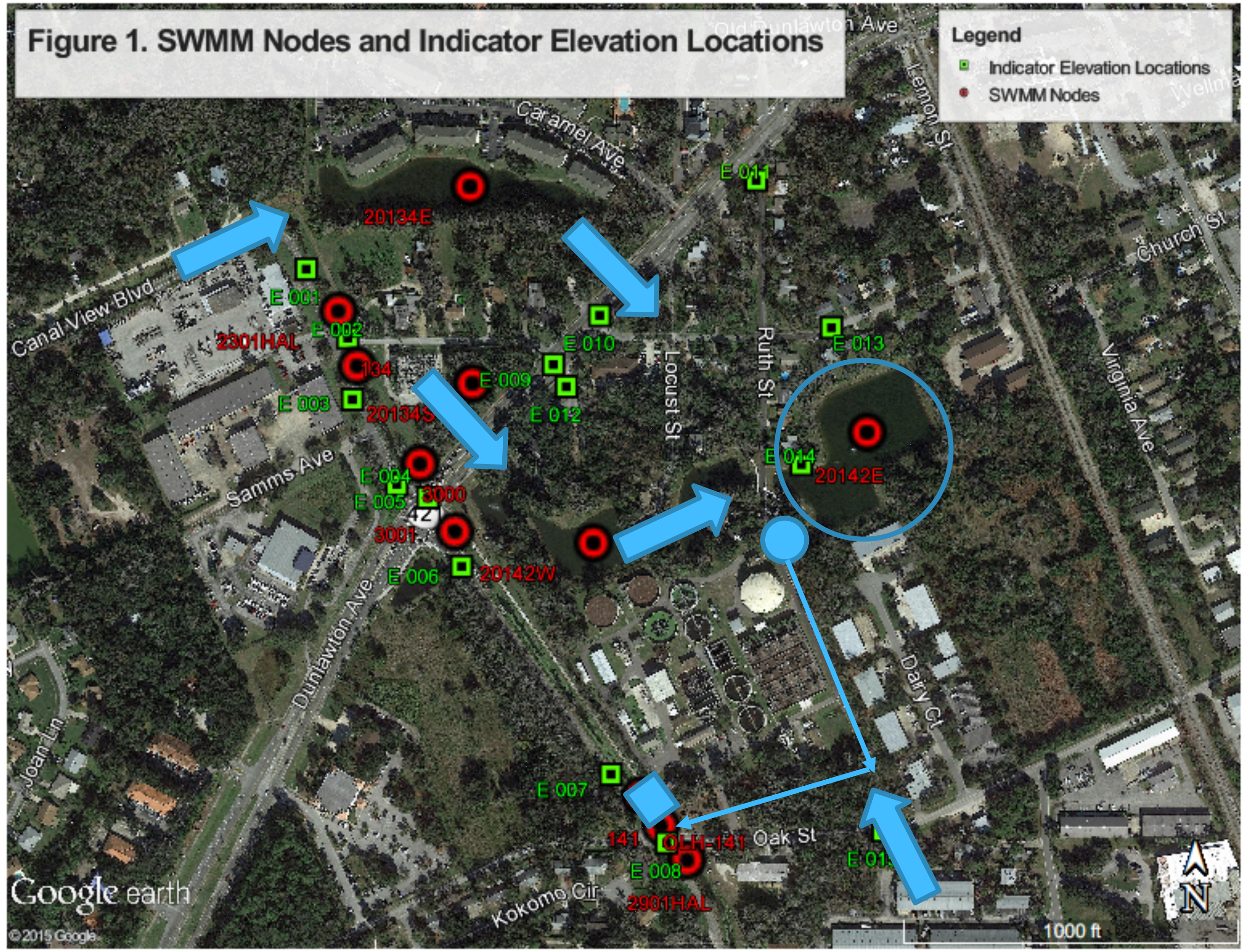
Alternative Evaluation – Current Flow Pattern

- Bank overflow into Sugar Mill Apartments area
- Flood overflow across Dunlawton to ponds
- Flow between ponds
- Backflow across Oak Street
- Pump to Halifax Canal



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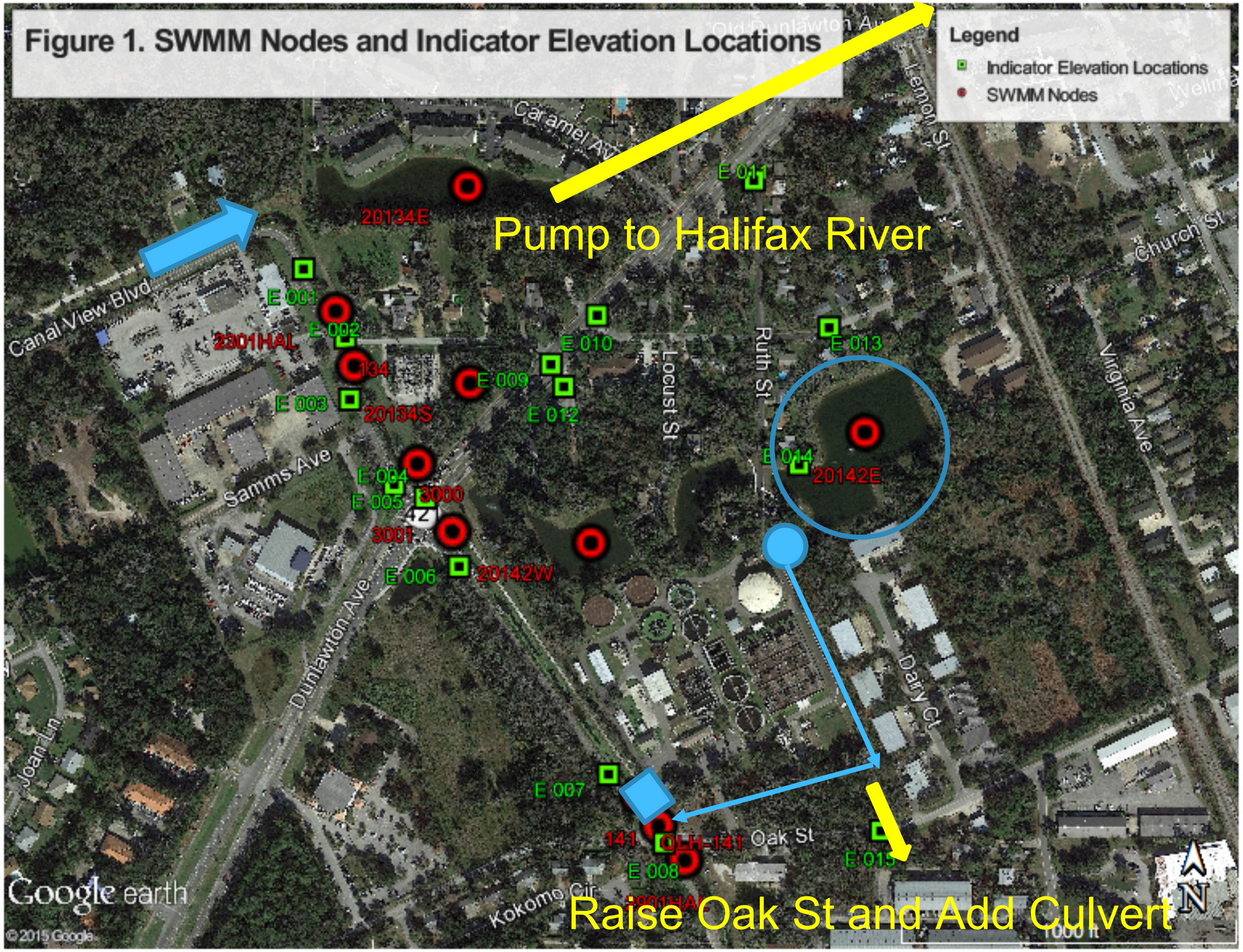
Alternative Features

- Control flooding and overland flow
- Pumping (125 cfs) from Sugar Mill Apts pond to Halifax River
- Pipe or channel from Dunlawton to the Sugar Mill Apts Pond
- Raise Oak Street to reduce backflow rate across Oak Street



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Conclusions/Recommendations

- The proposed berm would increase flooding in locations west of the berm and has limited reduction east and d/s of the berm
- It appears impractical to provide enough storage to control flood elevations (over 300 Ac-Ft)
- An effective alternative to reduce flooding includes:
  - Pumping of excess stormwater to Halifax River
  - Local conveyance improvements to proposed pump
  - Raising Oak Street to reduce potential backflow for large storms
- The alternative features would reduce peak flood elevations by 1 to 2 feet during extreme storm events (below identified road crowns)